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Twin guidewire technique for retrieval of retained guidewire in the coronary system

A técnica do duplo fio-guia para recuperação de guia retido no sistema coronário

Carolina Mywa Tomita[1], Isadora Martins de Sousa[1], Marcos Franchetti[2], Julio de Paiva Maia[2]

[1] *Universidade Estadual de Maringá, Maringá, PR, Brazil.*
[2] *Hospital Paraná, Maringá, PR, Brazil.*

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ABSTRACT – Entrapment and breakage of devices used in coronary interventions are rare complications, but have occurred with increasing frequency. Knowledge and mastery of techniques to rescue these materials are of paramount importance to solve these incidents. We report a successful withdrawal of a 0.014" retained guidewire in the coronary artery, by the so-called twin guidewire technique.

Keywords: Angioplasty, balloon, coronary/adverse effects; Angioplasty, balloon, coronary/instrumentation

RESUMO – Fratura e aprisionamento de dispositivos utilizados em intervenções coronarianas são complicações raras, mas que ocorrem cada vez mais frequentemente. O conhecimento e o domínio de técnicas para recuperação destes materiais são de fundamental importância para a solução destes incidentes. Relatamos a retirada bem-sucedida de um fragmento de fio-guia de 0,014 polegadas retido na artéria coronária, utilizando a técnica do duplo fio-guia.

Descritores: Angioplastia coronária com balão/efeitos adversos; Angioplastia coronária com balão/instrumentação

INTRODUCTION

In the last decade, percutaneous coronary interventions (PCI) has been increasingly performed in complex cases. This phenomenon enhanced the rate of complications, such as entrapment or breakage of angioplasty devices.[1] The leading causes of these events are plaque dislodgment, which can cause guidewire entrapment especially in tortuous anatomies and side branches; heavily calcified lesions and structural material failure.[2]

The treatment options for this condition include conservative management, percutaneous interventional techniques and surgical explantation.[3,4] Device entrapment may result in thrombosis, embolic phenomena, dissection, perforation, or vessel occlusion; therefore, their removal is recommended in most cases, either by surgical or percutaneous approach.

Previous data have shown multiple percutaneous techniques for the rescue of entrapped devices within coronary arteries, most of which using snares or balloon catheters. Gurley et al. first reported the double guidewire technique, used to withdraw a balloon catheter fragment.[5]

We present a case of a left anterior descending artery (LAD) and first diagonal branch (DB_1) bifurcation PCI, in which a previously placed stent caused the entrapment of a 0.014" guidewire, leading to disruption of the distal tip. The entrapped guidewire was successfully removed using this technique.

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Corresponding author
Marcos Franchetti
Serviço de Hemodinâmica, Hospital Paraná
Avenida Dr. Luiz Teixeira Mendes, 1.929, Zona 9
Zip code: 87015-001 – Maringá, PR, Brazil
E-mail: marcosfranchetti@hotmail.com

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CASE REPORT

A 70 year-old male patient, with previous history of proximal LAD PCI with Sirius carbostent 3.0x9mm (Sorin Biomedica Cardio, Saluggia, Italy) in 2002, underwent coronary angiography for atypical chest pain and positive nuclear test. There was mild in-stent hyperplasia and a calcified, eccentric, intermediate disease on medium segment and ostium of the DB_1 (Figure 1A). The fractional flow reserve (FFR) assessment was positive for LAD (0.76) and negative, but borderline, for DB_1 (0.81).

A double-stent technique was planned for the treatment of this bifurcation (Medina 0.1.1). After placement of the first 0.014" guidewire, in the distal portion of LAD, in an attempt to cross a second 0.014" ChoICE™ extra support guidewire (Boston Scientific, Marlborough, USA) through DB_1, the distal tip inadvertently entered through the stent struts and got entrapped into a small septal branch. At first, simple maneuvers were performed, such as traction, back and forth movements and, finally, clockwise and counterclockwise rotations, all of them unsuccessful (Figure 2A). The activated clotting time (ACT) was checked, and then measured every 30 minutes, and unfractionated heparin was given to keep the desired range (250 to 350 seconds). A FineCross® microcatheter (Terumo, Tokyo, Japan) and a Sprinter® low-profile 2.0x6mm balloon catheter (Medtronic, Minneapolis, USA) were advanced over the guidewire, but both devices did not succeed in reaching its distal tip, probably due to the twist formation during rotational movements performed (Figure 2B). In order to eliminate the twist, the LAD guidewire was removed, followed by new attempts using the microcatheter and the balloon catheter, without success.

After performing a new traction on the wire, unravelling of the guidewire was observed, with the distal tip still trapped in the septal branch (Figure 2C). The distal tip of the ChoICE™ extra support guidewire consists of a very thin metal wire, arranged in a spiral shape, on a tapered and rigid metallic central core, so the twin guidewire method was attempted.

Two 0.014" ChoICE™ extra support guidewires were positioned in parallel, with their tips distally to the point of the retained fragment in the arterial lumen, both under the same guidewire rotor, so that they could create a twist when rotated simultaneously in the same direction. This technique allowed the complete rescue of the entrapped guidewire (Figure 3). A control angiogram was performed, which revealed LAD and DB_1 with normal distal *Thrombolysis in Myocardial Infarction* (TIMI) flow and no dissection.

T-stenting and small protrusion (TAP) bifurcation technique was used with placement of three XIENCE PRIME stents (Abbott Vascular, Santa Clara, USA): a 2.25x28mm and a 2.75x18 mm stent, for the LAD, and a 2.5x15mm stent, for the DB_1 (Figure 1B).

Figure 1. Percutaneous coronary intervention. (A) Coronary angiography confirming mild in-stent hyperplasia and a calcified, eccentric, intermediate disease on medium segment and ostium of the first diagonal branch. (B) The result after performing the T-stenting and small protrusion bifurcation technique.

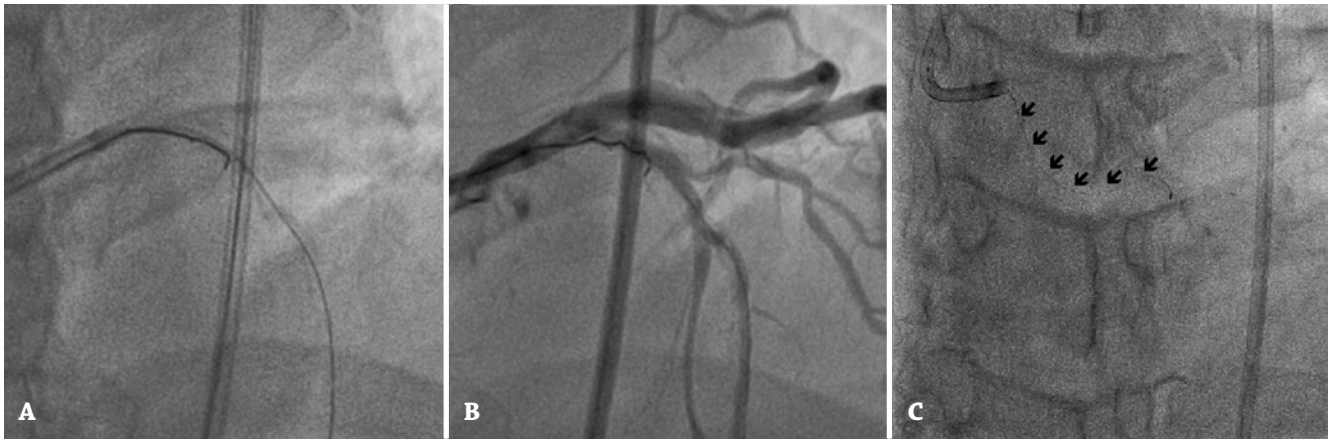

Figure 2. Entrapment and disruption. (A) The guidewire inadvertently entered through the stent struts and became entrapped in a small septal branch. (B) Twist formation created due to the rotational movements of a guidewire over the other. (C) After a new traction on the wire (black arrows), unravelling of the guidewire was observed, with the distal tip still trapped in the septal branch.

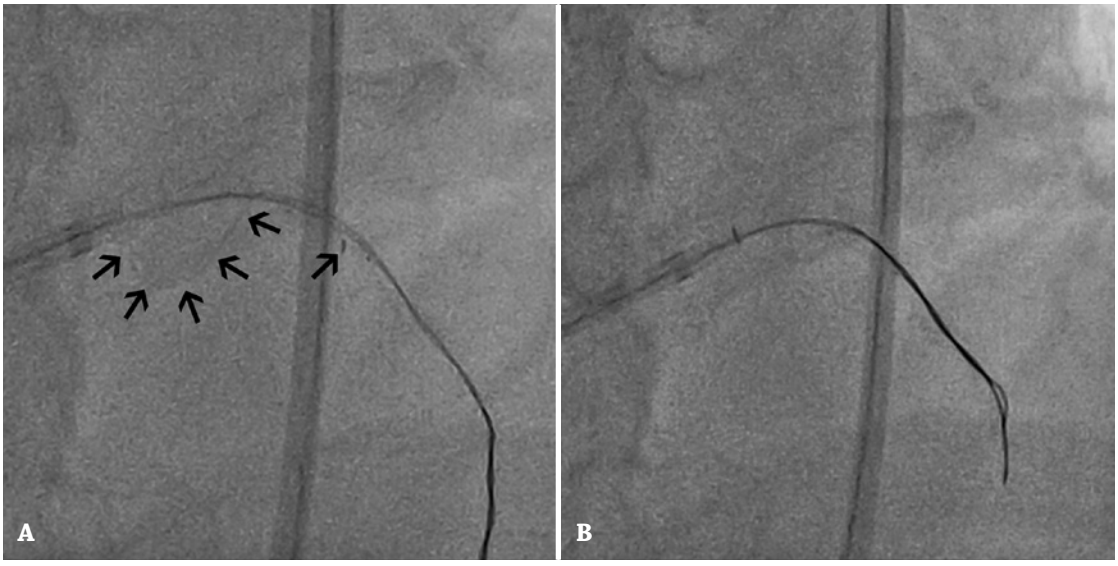

Figure 3. The twin guidewire technique. (A) The black arrows show the unravelled wire. (B) Retrieval of entrapped device by two twisted guidewires.

DISCUSSION

Broken and entrapped guidewires in coronary arteries are rare complications in interventional practice, and since they are only found in case reports, no evidence-based approach has been put forward relating to the proper use of a guidewire and the reduction of these complications. The reported incidence of entrapment or breakage of such devices during or after PCI ranges from 0.2% to 0.8%.[6,7]

The first case of entrapped guidewire was reported in 1980 and, in that occasion, the chosen procedure was surgical explantation.[8] Since then, new cases were reported, and despite the development of more flexible guidewires with higher quality, the incidence of such complication is the same, or has even increased, due to the number of complex cases made feasible by the technological improvement.

Within the coronary artery, an entrapped device can serve as a nidus for endothelial injury and further platelet deposition, leading to complications, such as emboli, thrombosis, dissection and rupture. Once the diagnosis of entrapment complication has been established, treatment options will depend on the site of entrapment, its extent and possible sequelae caused by the foreign body. Some available alternatives for solving this complication are conservative management, percutaneous interventional techniques or surgery.

Conservative management may be appropriate after attempts at retrieval broken fragments of a guidewire have been unsuccessful and the intervention risks are

higher than the benefits in a certain patient, such as in cases in which the foreign body is in a very distal branch and will not cause ischemia.[2]

Homemade and manufactured snares, low-profile balloon catheters, retrieval basket devices, biliary forceps and the double guidewire technique are examples of different percutaneous retrieval techniques. However, due to their size, the biliary forceps and the retrieval basket can only be used in large arteries (i.e. aorta and femoral/iliac arteries).[6] Hung et al. also showed that poor handling and rigidity of snares hindered this approach while dealing with more distal sites in tortuous vessels.[9] The low-profile balloon catheter technique is appropriate in cases in which the fragments are located in the proximal portions of the coronary arteries. It consists of advancing a low-profile balloon catheter and placing it distally to the retained device, with subsequent inflation and traction, in order to remove the fragment from the artery.[10]

It is known that any foreign body left in the coronary arteries must be removed as soon as possible to avoid future complications. The percutaneous interventional techniques should be used as the first choice. Nevertheless, excessive and repetitive efforts may cause new damage in atherosclerotic vessels, and are, sometimes, inefficient. In these cases, surgical removal is recommended, mainly in patients who develop acute myocardial infarction.[5]

In the aforementioned case, the twin guidewire technique was performed, and it was also described as double-helix method by Hung et al.,[9] and as double-wire technique by Demircan et al.,[7] to remove a distal part of a guidewire and of a balloon retained in the distal segment of the circumflex artery, respectively. Besides being an viable and safe technique, it is easy to handle and allows the rescue in the most distal points of the coronary arteries, which makes this approach a good choice in cases where other percutaneous methods were ineffective. The major restriction to this technique is the retrieval of a stent because of the difficulty in keeping them tight on the guidewires during traction.

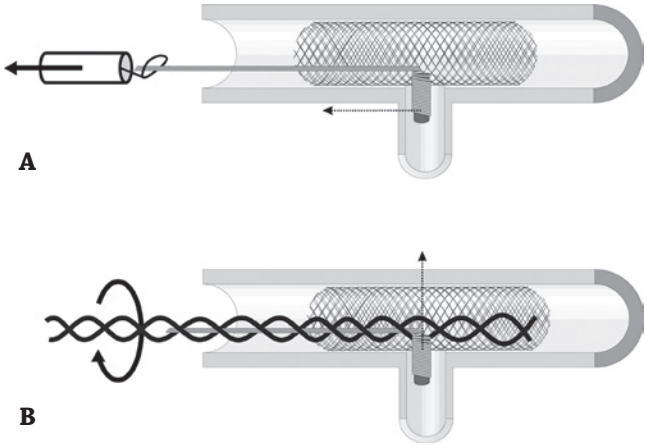

Figure 4. Percutaneous retrieval techniques. (A) Snare retrieval technique. (B) Twin guidewire technique.

In the present case, the distal tip of the guidewire became entrapped in a 90º angle septal branch, with the long axis of DB_1 in an elongated spiral. Due to this angulation, the use of a snare would not be effective, because the traction of the guidewire over the stent struts would be perpetuated, by pulling in the same direction as the vector that caused rupture of the wire (Figure 4A). Moreover, it would increase the risk of dissection of the proximal LAD, as well as the left main coronary artery.

The technique performed with two simultaneously rotated guidewires was effective, once it created a twist that enabled not only capturing the guidewire by its proximal edge located in the aorta, but also twisting the elongated spiral progressively, from proximal to distal LAD. This process was carried on until the wire was very close to the septal branch, up to the point where the traction angle was approximately zero, and there was no friction between the guidewire with the stent struts allowing its dragging to the LAD lumen and subsequent withdrawal from the coronary system (Figure 4B).

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